21_Clase

lunes, 22 de abril de 2019 07:17 a. m.

Temas
- Redes de Capacitores
- Corriente eléctrica
- Ley de Ohm
- Ley de Joule

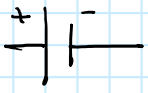
- **Capacitancia**: Es una característica intrinseca de los cuerpos que no depende del voltaje ni de la carga

$$C = \frac{\varepsilon A}{d} \quad ; \quad C = \frac{2\pi\varepsilon l}{L\frac{b}{a}} \quad ; \quad C = \frac{4\pi\varepsilon}{\frac{1}{a} - \frac{1}{b}}$$

-

Capacitor Variable

Placas paralelas



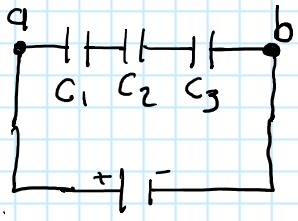
Fuente de Carga Eléctrica

Pilas/Baterias
- Primarias (No recargables)
- Secundarias (Recargables)

Conexión Serie: Es cuando para ir de un lado a otro se debe pasar por todos los elementos

Fases
- Sólido → Electrones
- Líquido → Electrones, Iones (Todo tipo)
- Gas → Iones (Todo tipo)
  - Los electrones son afectados por los iones, por eso no hay

Capacitores en Serie



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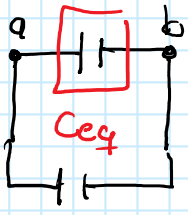


$$q_1 = q_2 = q_3$$

$$V_{ab} = V_{ad} + V_{de} + V_{eb}$$

- $C = \frac{q}{V}$; $C_1 = \frac{q_1}{V_{ad}}$ $\quad C_2 = \frac{q_2}{V_{de}}$ $\quad C_3 = \frac{q_3}{V_{eb}}$

$$V_{ad} = \frac{q_1}{C_1} \qquad V_{de} = \frac{q_2}{C_2} \qquad V_{eb} = \frac{q_3}{C_3}$$

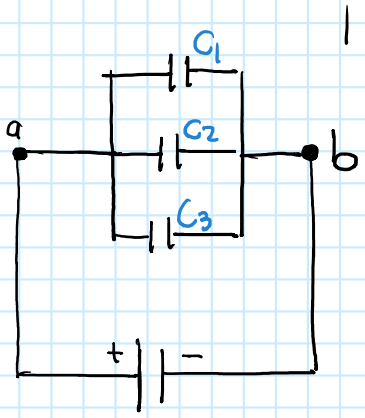
- $C_{eq} = \frac{q_{eq}}{V_{ab}}$; $V_{ab} = \frac{q_{eq}}{C_{eq}}$

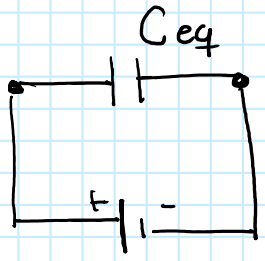
$$V_{ab} = \frac{q_1}{C_1} + \frac{q_2}{C_2} + \frac{q_3}{C_3} = \frac{q_{eq}}{C_{eq}}$$

$$\therefore \frac{1}{C_{eq}} = \sum_{k=1}^{n} \frac{1}{C_k}$$

▶ Conexión en Para elo

Para ir del punto inicial al final tenemos tantos caminos como elementos se tengan



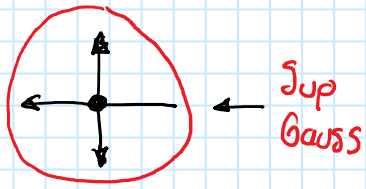


- Unión: Donde concurren 2 elementos
- Nodo: Donde concurren más de 2 elementos
- Rama: Lo que está entre nodo y unión
- Ramal: Lo que está entre 2 nodos
- Malla

▶ En un nodo

$$\bar{\nabla} \cdot \bar{E} = \frac{1}{\varepsilon} \rho \; ; \; \bar{\nabla} \cdot \varepsilon \bar{E} = \rho$$

- En un nodo



$\nabla \cdot E = \frac{\rho}{\varepsilon}$; $\nabla \cdot \varepsilon E = \rho$

$\varepsilon E = D$;

$\bar{\nabla} \cdot D = \rho$

En el nodo la carga encerrada es cero

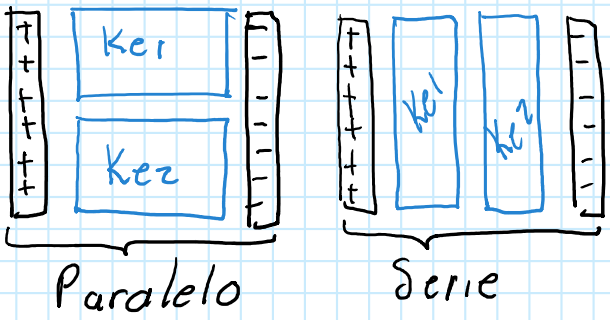
$\therefore q_{entrada} = q_{salida}$

$$q_1 + q_2 + q_3 = q_{eq}$$

$C_1 = \frac{q_1}{V_{ab}}$; $q_1 = C_1 V_{ab}$ | $C_2 = \frac{q_2}{V_{ab}}$; $q_2 = C_2 V_{ab}$

$\rightarrow C_{eq} V_{ab} = C_1 V_{ab} + C_2 V_{ab} + C_3 V_{ab}$

$$\therefore C_{eq} = \sum_{k=1}^{n} C_k$$



Asimilación respecto a los capacitores hechos.

Electrodinámica

Corriente Eléctrica | Es un flujo de carga eléctrica "i"

$$i = \frac{q_{Final} - q_{inicial}}{t_{Final} - \cancel{t_{inicial}}^{\,0}} = \frac{\Delta q}{\Delta t} ; \; i = \frac{q}{t} \left[\frac{C}{s}\right]$$

$$i = \frac{q}{t} \qquad \lim \Delta t \to 0 \; ; \; \lim \Delta t \to 0$$

$$\therefore \; i = \frac{dq}{dt} \; ; \quad \int i\,dt = \int dq \; ; \quad q = \int_0^T i\,dt$$

$$i = \frac{Nq}{\Delta t}$$

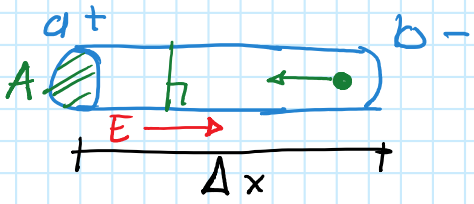
$N \triangleq$ Número de partículas con carga

$\Delta t \triangleq$ Diferencia de tiempo

$$\Delta q = N q_p \qquad n = \frac{N}{Vol}$$

n = Número de partículas con carga por unidad de Volumen

$$Vol = (\Delta x)\, A$$



$$i = \frac{\Delta q}{\Delta t} = \frac{N q_p}{\Delta t} = \frac{n q_p A \Delta x}{\Delta t} = n q_p \bar{V} \cdot \bar{A}$$

V

Vector Velocidad

Intensidad de Corriente: Es la cantidad de carga que pasa por la sección recta de un conductor por unidad de tiempo

$$i = n q_p \bar{V} \cdot \bar{A} \cancel{\cos 0^\circ} \; ; \quad i = n q_p V A$$

22_ Clase

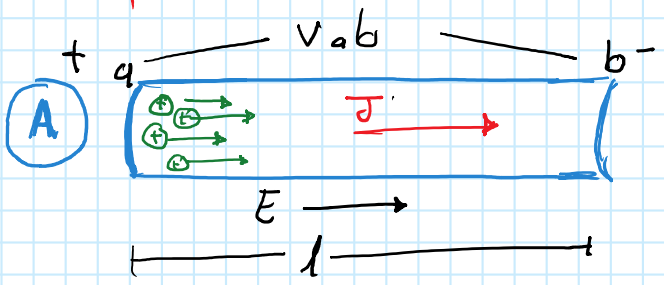
miércoles, 24 de abril de 2019 07:15 a. m.

- Corriente Eléctrica
- Ley de Ohm
- Densidad de Corriente
- Ley de Joule
- Potencia Eléctrica
- Resistencia Eléctrica
- Calibres de Conductores

Nota:
- Sentido de la corriente $\oplus \xrightarrow{i} \ominus$
- Sentido de los electrones $\ominus \xrightarrow{e^-} \oplus$

Corriente Eléctrica

$$i = \sum_{k=1}^{n} n_k q_k v_k A$$



$\vec{J} \triangleq$ Es un vector

- $J \triangleq$ Densidad de Corriente: La corriente por unidad de área

$$J = \frac{di}{dA} \; ; \quad di = \vec{J} \cdot \vec{dA} \; ; \quad i = \int \vec{J} \cdot dA$$

$E \rightarrow J$
$J = f(E)$

$$J \sim E \; ; \quad J = \sigma E$$

σ ← cte

$$\sigma = f\left(\begin{matrix}\text{material del}\\ \text{conductor}\end{matrix}\right) \triangleq \text{Conductividad Eléctrica}$$

Ley de Ohm: $J = \sigma E$

Ley de Ohm $\bar{J} = \tilde{\sigma}\,\bar{E}$

$\bar{J} = \dfrac{di}{dA}$; $\dfrac{di}{dA} = \tilde{\sigma}\,\bar{E}$; $di = \tilde{\sigma}\,E\,dA$ | $\tilde{\sigma} =$ Ctes, $E =$

$\int_0^i di = \int_0^A \sigma E\,dA$; $i = \sigma E A$

$\bar{E} = -\bar{\nabla} V$ | $\bar{E} = -\dfrac{dv}{dx}$

$\nabla v = \dfrac{dv}{dx}$

$\therefore\ i = \sigma - \dfrac{dv}{dx} A$; $-dv = \dfrac{i}{\sigma A} dx$

$\int_a^b -dv = \int_{xa}^{xb} \dfrac{i}{\sigma A} dx$; $-(V_b - V_a) = \dfrac{i}{\sigma A}(x_b - x_a)$

$V_b - V_a = V_{ba} = -V_{ab}$ | $\tilde{\rho} = \dfrac{1}{\tilde{\sigma}} \triangleq$ Resistividad

$V_{ab} = \dfrac{i}{\tilde{\sigma}} \dfrac{l}{A}$ | $\tilde{\rho} = F(\text{material})$

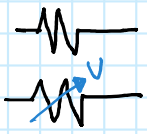
$V_{ab} = \dfrac{\tilde{\rho}\, l}{A}\, i$ | $R \triangleq$ Resistencia Eléctrica $= \dfrac{\tilde{\rho}\, l}{A}$

Ley de Ohm

- $V_{ab} = R\,i$
- Volts = (Ohm)(Ampere)

Ohm | Volts - [Ohm] [Ampere]

- La resistencia de un cuerpo será de 1 [Ω] cuando al conectarla a una diferencia de potencial y la corriente es de 1 [Ampere].

R | Ohm | 

*Reostato

- $R = \hat{\rho}\frac{l}{A}$; $\hat{\rho} = R\frac{A}{l}$ [Ohm · m]
- $\hat{\sigma} = \frac{1}{\hat{\rho}}$ $\left[\frac{Mhos}{m}\right]$
- Conductancia $= G = \frac{1}{R}$ [Mhos]

Resistencia Eléctrica | Es una propiedad intrinseca de los cuerpos no depende ni del voltaje ni de la corriente sino de sus dimensiones y del material que está hecho.

→ Potencia Eléctrica

$$\text{Potencia} = \frac{dE_p}{dt};$$

$$V = \frac{E_u P}{q}; \quad E_u P = qV; \quad \Delta E_p = (q_f - q_i)V_{ab} = \Delta q V_{ab}$$

$$P = \frac{\Delta E_p}{\Delta t} = \frac{\Delta q V_{ab}}{\Delta t}; \quad P = V_{ab}\, i$$

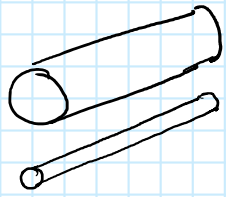
- **Choques** { Inelásticos → Se libera en calor

• Choques { Inelásticos → Se libera en calor
Elásticos

$P_{disipada} = i^2 R$ //

▶ $V = R i$ | ▶ Corto Circuito | ▶ Circuito Abierto

$R \to 0$ $i \to \infty$ | $R \to \infty$ $i \to 0$

▶ 

• Calibre − 0) 80%
− ~~1~~ → No se fabrican nones
− 2
− ~~3~~
− 4

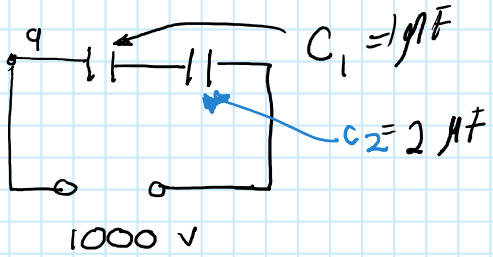
▶ Unidad Circular | Circular Mil [CM] | (A) .001" | A = 1 cm
//Milésima de pulgada

∴ MCM ≜ Mil circular mil

23_clase

lunes, 29 de abril de 2019 07:30 a. m.

8.12] Tarea



$$C_{eq} = \frac{1}{\frac{1}{1} + \frac{1}{2}} = \frac{2}{3}\ [\mu F]$$

- $C = \frac{q}{V}$; $q = CV$
- $q_{eq} = C_{eq} V = \left(\frac{2}{3} \times 10^{-6}\right)(1000) =$

$$= \frac{2}{3} \times 10^{-3}\ [C]$$

- $q_1 = q_2 = q_3$

- $V_{ad} = \frac{q_1}{C_1} = \frac{\frac{2}{3} \times 10^{-3}}{1 \times 10^{-6}} =$

$$= 666.66\ [V]$$

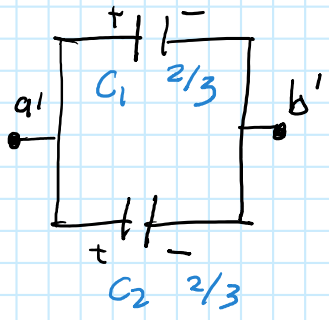
- $V_{db} = \frac{q_2}{C_2} = \frac{\frac{2}{3} \times 10^{-3}}{2 \times 10^{-6}} =$

$$= 333.33\ [V]$$

// Verificando

$$V_{ab} = V_{ad} + V_{db} = 1000\ [V]$$

b)



$$C = \frac{q}{V_{ab'}}$$

$$q_1 + q_2 = q_1' + q_2'$$

$$4/3 \times 10^{-6} = q_1' + q_2'$$

$$V_{ab'} = \frac{q_1'}{C_1} = \frac{q_2'}{C_2} \ ; \ q_1' = \frac{C_1}{C_2} q_2'$$

// Redefiniendo

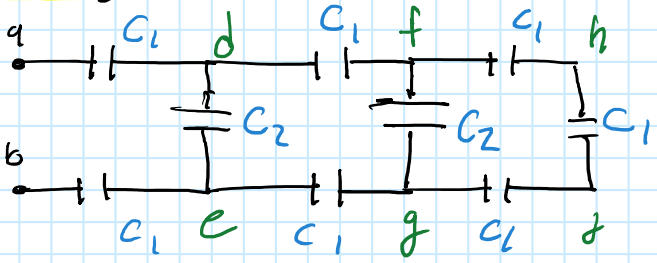
$$\frac{4}{3} \times 10^{-3} = \frac{C_1}{C_2} q_2' + q_1' \ ; \ q_2' = \frac{\frac{4}{3} \times 10^{-3}}{1 + \frac{1}{2}} = \frac{8}{9} \times 10^{-3}\ [C]$$

$$q_1' = \frac{1}{2} q_2' \; ; \; q_1' = \frac{4}{9} \times 10^{-3} [C]$$

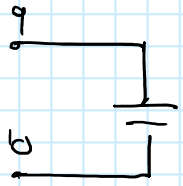
// Comprobación

$$q_1' + q_2' = \left(\frac{4}{9} + \frac{8}{9}\right) \times 10^{-3} = \frac{4}{3} \times 10^{-3} [C] = q_1 + q_2$$

8.16]



- $C_1 = 3\,\mu F$
- $C_2 = 2\,\mu F$



- $C_{eq} = 1\,\mu F$
- $V_{ab} = 900\,[V]$

- $C = \frac{q}{V}$; $q = CV$

$\therefore$
- $q_{eq} = 900\,[\mu C]$
- $V_{ab} = 300\,[V]$
- $V_{ad} = 300\,[V]$
- $V_{cb} = 300\,[V]$

- $q_{de} = (2\,\mu F)(300\,V) = 600\,\mu C$
- $q_{eq_3} = (1\,\mu F)[300\,V] = 300\,\mu C$
- $q_{de} + q_{eq_3} = q_{eq} = 900\,[\mu C]$

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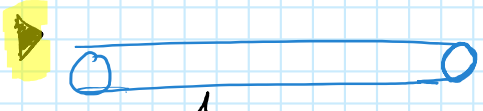
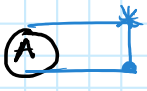
1) Resistencia Eléctrica
2) Tipos de corriente
3) Valores medios y eficaz de una corriente variable



Alambre

$$R = \frac{\rho l}{A}$$

$\rho_{cobre} = 1{,}72 \times 10^{-8}$ a $20°$



.010"

i (A) .010

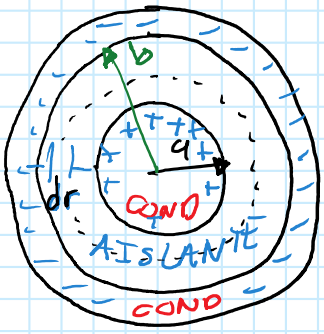
//Sustituyendo

$$A = \frac{(\pi)(D^2)}{4} = \left(\frac{\pi}{4}\right)\left(.10 \times 2.54 \times 10^{-3}\right)^2 =$$

$$\therefore R = \frac{(1.72 \times 10^{-8})(1000)}{(h)(\quad)} =$$

$* \; h \triangleq$ hilos

▸ Cable



- Resistencia Aislante
- Área $\triangleq$ Es variable
- longitud de a hasta b

$$dR = \frac{\hat{\rho}\, dr}{A} \; ; \; \int dR = \int \frac{\hat{\rho}\, dr}{A}$$

Área de la cara cilindro

- $$R = \hat{\rho} \int_a^b \frac{dr}{2\pi r l} = \frac{\hat{\rho}}{2\pi l} \int_a^b \frac{dr}{r} =$$

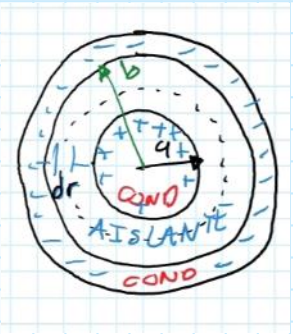
$$R = \frac{\hat{\rho}}{2\pi l} \ln \frac{b}{a}$$

- V_{ab}; $i_{fuga} = \dfrac{V_{ab}}{R_{cilindro}}$

▸ Esferas

$$R = \frac{\hat{\rho}\, l}{A}$$

$$\int dR = \frac{\hat{\rho}\, dr}{\quad} = \int \frac{\hat{\rho}\, dr}{\quad}$$



$$\int dR = \frac{\hat{\rho}\, dr}{A} = \int \frac{\hat{\rho}\, dr}{4\pi r^2}$$

$$\therefore R = \frac{\hat{\rho}}{4\pi}\left[\frac{1}{b} - \frac{1}{a}\right]$$

$\hat{\rho} \triangleq cte$ // Pero realmente no lo es

$\hat{\rho} \sim \frac{1}{r}$ $\therefore$ Considerar nuevo modelo

// Parte mia

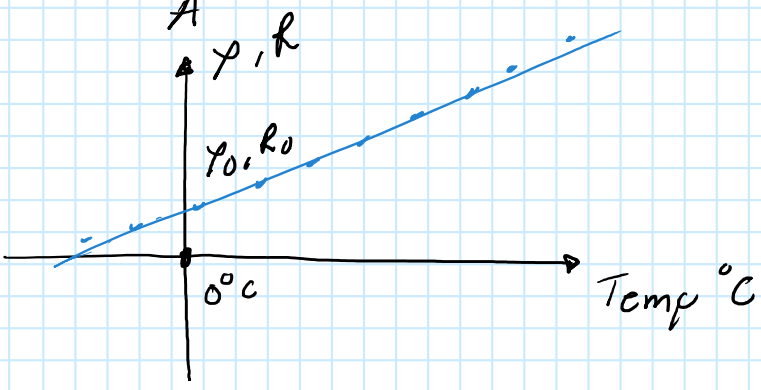
$$R = \int_a^b \frac{\hat{\rho}\, dr}{4\pi r^2} = \qquad \hat{\rho} = \frac{1}{r} K \qquad K = \text{cte arbitraria}$$

$$= \int_a^b \frac{\frac{1}{r} K\, dr}{4\pi r^2} = \frac{K}{4\pi}\int_a^b \frac{\frac{1}{r}}{\frac{r^2}{1}}\, dr = \frac{K}{4\pi}\int_a^b \frac{1}{r^3}\, dr$$

$$= \left(\frac{K}{4\pi}\right)\left(-\frac{1}{2(b)^2} + \frac{1}{2(a)^2}\right)$$

Resistencia y Temperatura

$$R = \frac{\hat{\rho}\, l}{A}$$



- $\rho = \rho_0 + at + bt^2 + ct^3 + dt^4$
- $a, b, c, d \triangleq cte$ f(material)
- $t = \Delta t$

$$\hat{\rho} = \hat{\rho}_0 + at = \hat{\rho}_0\left(1 + \frac{a}{\rho_0} t\right)$$

$\frac{a}{\rho_0} \triangleq$ Coeficiente térmico de resistividad a 0°C

$$\rho = \rho_0 (1 + \alpha_0 t)$$

$\frac{a}{\rho_0}$ = Coeficiente térmico de resistividad a 0°C

$\rho = \rho_0 (1 + \alpha_0 t)$

$$\therefore R = \frac{\rho l}{A} = \frac{l}{A} \rho_0 (1 + a_0 t) = R_0 (1 + \alpha_0 t)$$

// Con valores

* NOTA

$$R_{20°C} = R_0 (1 - \alpha_0 (20°))$$

$$\alpha_0 = 3.93 \times 10^{-3} \ °C^{-1}$$

$R_{40°C} = ¿?$

$$R_{40°} = R_0 (1 + 40 \alpha_0)$$

$$R_{20°} = R_0 (1 + 20 \alpha_0)$$

$$; \ R_{40°} = (R_{20}) \left[\frac{1 + 40 \alpha_0}{1 + 20 \alpha_0} \right]$$

$$\therefore R_0 = \frac{R_{20}}{1 + 20 \alpha_0}$$

// Para semiconductores se usa un signo menos debido a su resistividad

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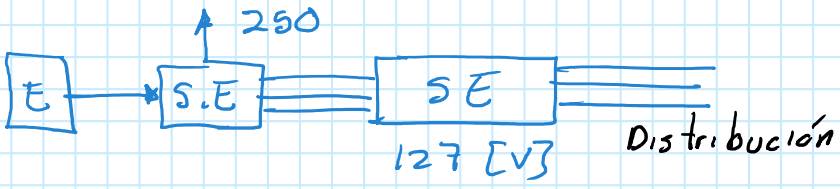
DATOS

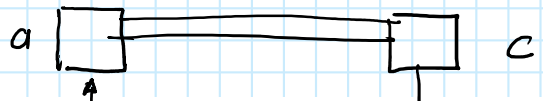
- 6 salones
- 20 focos
- 75 Watts
- 127 Volts

Expresiones

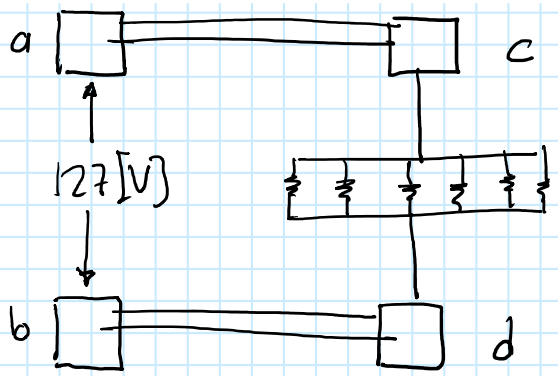
- Potencia $= V i = R i^2 = \frac{V^2}{R}$
- $V = R i$

$$R_{foco} = \frac{V^2}{\text{Potencia}}$$





* Caída de Voltaje



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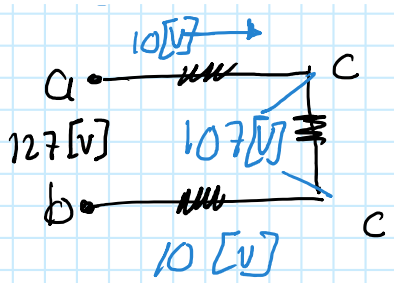


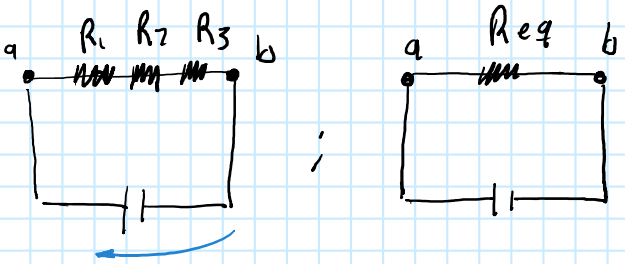
- $A_{conductor} = d?$

$$V_{ab} = V_{ac} + V_{cd} + V_{db}$$

24_clase

lunes, 6 de mayo de 2019 07:19 a. m.

Serie



- $R_{eq} = \sum_{k=1}^{n} R_k$
- $V_{ab} = V_{ac} + V_{cd} + V_{db}$

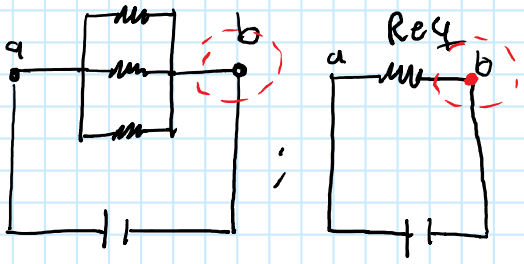
$V_{ac} = R_1 i$

$V_{cd} = R_2 i$

$V_{db} = R_2 i$

$\therefore R_{eq} I = R_1 i + R_2 i + R_3 i$

Paralelo



superficie Gauss

$N = \int_{S.C} E \cdot dA = \frac{1}{\varepsilon} q$;

$\int \varepsilon E \cdot dA = q$;

// $J = \bar{\sigma} \cdot E$; $E = \frac{J}{\bar{\sigma}}$

$\therefore \int_{S.C} \varepsilon \frac{J}{\bar{\sigma}} \cdot dA = q$;

$= \frac{\varepsilon}{\bar{\sigma}} \int J \cdot dA = q$

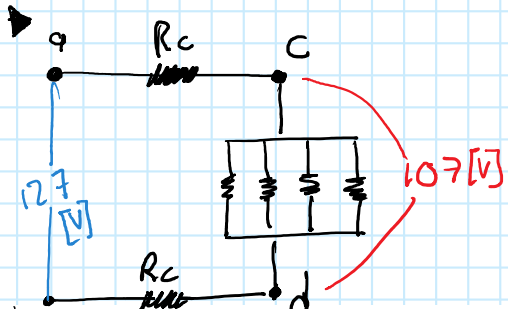
//Para estar en el nodo

- Cerrada $\rightarrow 0$
- $q = 0$

$\therefore \int_{S.C} J \cdot dA = 0$; $q_{entrada} = q_{salida}$

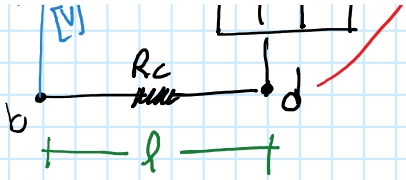
J - Densidad de Corriente

$|J| = 0$ $\quad \cancel{|dA|} = 0$ $\quad \cancel{J \perp dA}$



- $V_{ac} + V_{cd} + V_{db} = V_{ab}$

- $R_{ac} = \frac{\frac{1}{\gamma_{ac}} l_{ac}}{A_{ac}}$ • $\frac{1}{\gamma_{ac}} = \frac{1}{\gamma_{db}} = \frac{1}{\gamma_{cable}}$



$$\frac{\quad}{A_{ac}}$$

$$\cdot R_{db} = \frac{\rho_{db}\, l_{db}}{A_{db}}$$

$$V_{ab} = i_{ac} R_{ac}$$

$$V_{db} = i_{db} R_{db}$$

//Datos

- 120 focos
- 75 W
- 127 V

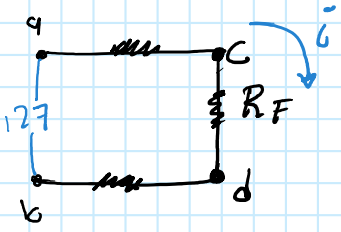
$R_{foco} = ?$

$$\cdot P = i^2 R = \frac{V^2}{R} \; ; \quad R_{foco} = \frac{V^2}{P} = \frac{127^2}{75} = 215.05\,\Omega$$

$$i = \frac{V}{R}$$

$$\cdot \frac{1}{R_{eq}} = \frac{120}{127^2} \; ; \quad R_{eq} = \frac{127^2}{120} = 1.79\,\Omega$$

$$\cdot V_{cd} = i_{cd} R_F$$



$$i_{ac} = i_{bd} = i_{cd} = i$$

$$l_{ac} = l_{cd} = l$$

$$A_{ac} = A_{cd} = A$$

$$\therefore V_{ac} = i R_{ac} = i \frac{\rho l}{A}$$

$$V_{db} = i R_{db} = i \frac{\rho l}{A} \; ; \quad V_{ac} = V_{db}$$

$$// V_{ab} - V_{cd} = V_{ac} + V_{db} \; ; \; V_{ac} = \frac{V_{ab} - V_{cd}}{2}$$

$$\therefore V_{ac} = \frac{127 - 107}{2} = 10\,[V]$$

$$V_{ac} = i R_{cable} \; ; \; V_{cd} = i R_{cd} \; ; \; i = \frac{V_{cd}}{R_{cd}} = \frac{107}{1.79} =$$

$$\therefore i = 59.77\,[A_{rms}]$$

$\therefore i = 59.77$ [Amperes]

100 [m]

$$V_{ac} = i\,\frac{\hat{\rho}\,l}{A} \;;\quad \frac{V_{ac}}{i} = \frac{\hat{\rho}\,l}{A} \;;\quad \frac{10}{59.77} = \frac{(1.72\times10^{-8})(100)}{A}$$

$$\therefore A = (59.77)(1.72\times10^{-8}) = 10.2\times10^{-6}\ m^2 = 10.2\ [mm^2]$$

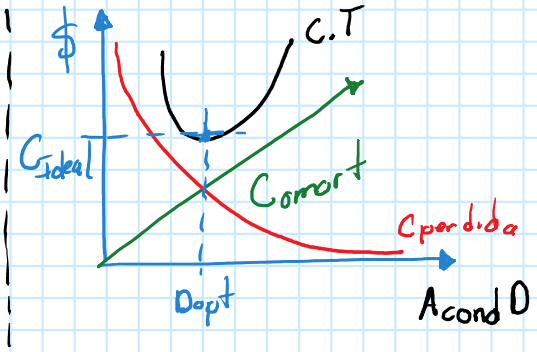
$$A = \frac{\pi}{4}\,\text{diametro}^2 \;;\quad D = \sqrt{\frac{4}{\pi}A} = 3.6\,[mm]$$

Si consideramos la temperatura:

* $R_{20} = R_0(1 + 20\,\alpha_0)$
* $R_{50} = R_0(1 + 50\,\alpha_0)$; $R_{50} = R_{20}\left(\frac{1+50\,\alpha_0}{1+20\,\alpha_0}\right)$

• $P_{disipada} = (i^2 R_{conduc})_{20°C}$ 2

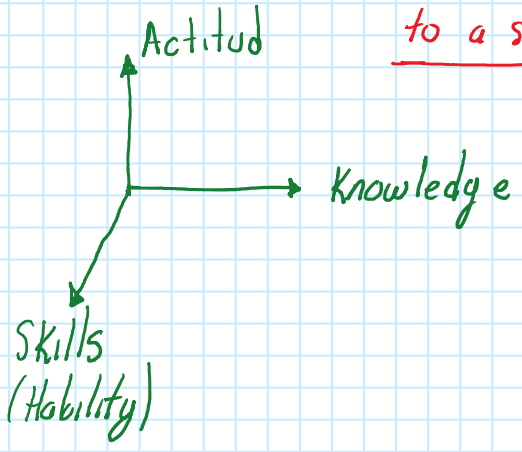
• $P_{disipada} = (i^2 R_{conduc})_{50°C}$ 2



$C_T = C_A + C_P =$

$$\frac{dC_T}{dA} \overset{\Delta}{=} \text{Valor óptimo}$$

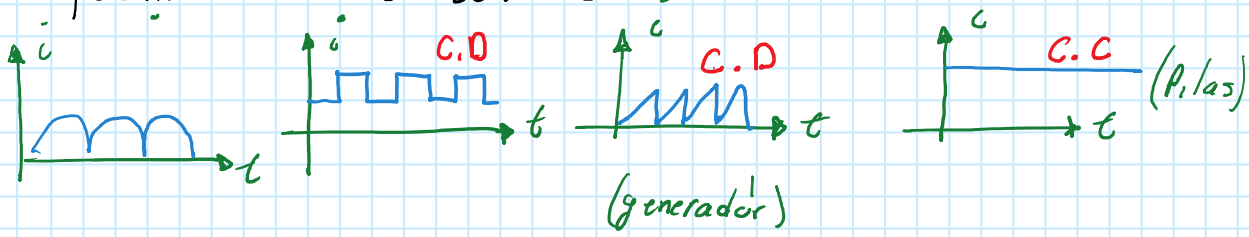
From a sensei to a student



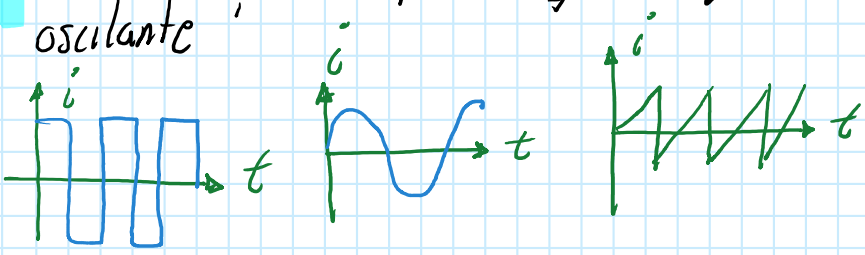
Tipos de Corrientes

Tipos de Corrientes

- **Corriente pulsante**: Es aquella que viaja siempre en un solo sentido

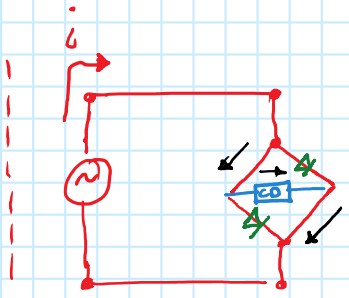


- **Corriente oscilante**: Es aquella que viaja en 2 sentidos



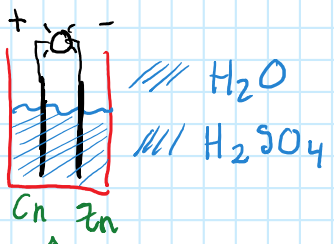
- **Corrientes Periódicas**
  - Son aquellas que transcurridos un tiempo ($T \triangleq$ Período) repiten su serie de valores
  - Éstas pueden ser pulsantes como oscilantes

- **Corriente Alterna**
  - Es una corriente oscilante y periódica



- **Valor Medio**
  - Es aquella corriente continua e imaginaria que produce la misma cantidad de depositivo electrolítico que la corriente variable en un mismo período t

$$\rightarrow i = \frac{dq}{dt} \; ; \; \int_0^q dq = \int_0^T i\,dt \; ; \; q = \int_0^T i\,dt$$



Deposito Electrico

$i_{c.c.I} = i_{medio} = i_{av} = cte$

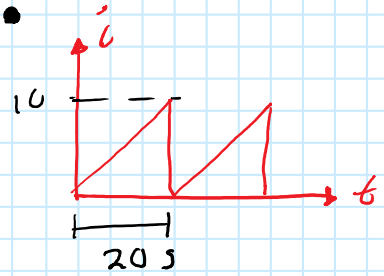
$i_{variable} = i$

$q_{c.v} = q_{c.c.i}$

$$\int_0^T i_v dt = \int_0^T i_{cci}\, dt \; ; \; i_{cci} = \frac{1}{T}\int_0^T i\, dt$$

// First Moment

// Examples

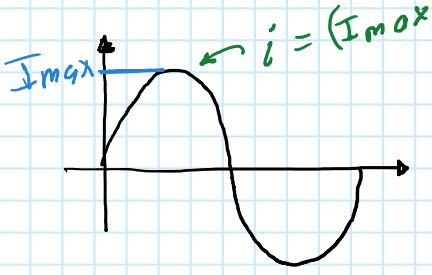
- 

$$i_m = \frac{1}{T}\int_0^T i\, dt =$$

$$= \frac{1}{20}\int_0^{20} \frac{10}{20}\, t\, dt =$$

$$= \frac{1}{\cancel{20}}\,\frac{10}{\cancel{20}}\,\frac{1}{2}\,[\cancel{400}-0] = 5\,[A]$$

// Extra | Tarea



$i = (I_{max})(\operatorname{sen}\omega t)$

$$\omega = \frac{d\theta}{dt} \; ; \; \omega\, dt = d\theta$$

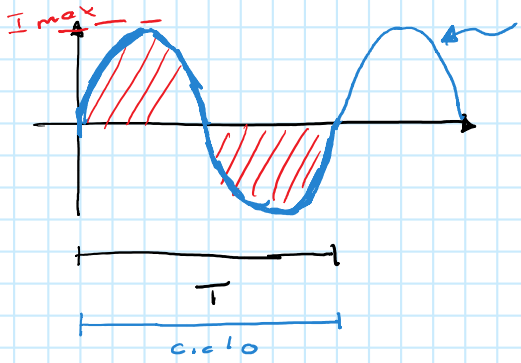
$$\therefore \theta = \omega t$$

$i_m =$

$i_{eficaz} =$

25_clase

miércoles, 8 de mayo de 2019 07:19 a. m.



$i = I_{max} \operatorname{sen} \omega t$

- $\omega = \frac{d\theta}{dt}$; $d\theta = \omega dt$; $\theta = \omega t$
- Frecuencia $= \frac{1}{T}$ $\left[\frac{\text{ciclos}}{\text{segundos}}\right]$

$$i_m = \frac{1}{T}\int I_{max} \operatorname{sen} \omega t \, dt = \frac{I_{max}}{\omega T}\left[-\cos \omega t\right]\Big|_0^T =$$

$$= \frac{I_{max}}{\omega T}\left[\underbrace{-\cos 2\pi}_{-1} + \underbrace{\cos 0}_{1}\right] \to 0$$

$$\therefore i_m = 0 \text{ [Amperes]}$$

Conclusión: Valor medio sirve para corrientes pulsantes.

Valor eficaz (Efectos):
1. Depósito electrolítico
2. Disipación de calor
3. Campos magnéticos

Valor Eficaz: Es aquella corriente continua e imaginaria que produce la misma disipación de calor que la corriente variable en un mismo período.

Pot. disipada $= i^2 R$ | $H \triangleq$ Calor

$P = \frac{d\,\text{Calor}}{dt}$ | $\therefore$ Pot. disip $= \frac{dH}{dt}$

$$P = \frac{d\,Calor}{dt} \qquad ! \therefore \text{ Pot. disp} = \frac{dH}{dt}$$

$$dH = i^2 R\,dt \;;\quad \int_0^H dH = \int_0^T i R\,dt \;;$$

$$H = \int_0^T i^2 R\,dt$$

$$H_{ccc} = H_{icv} \;;\quad \int_0^T i_{cci}^2 R\,dt = \int_0^T i_{cv}^2 R\,dt$$

$$i_{cv} = i \;;\quad i_{cci} = i_{ef} \overset{\Delta}{=} cte \qquad i_{ef} = i_{rms}$$

$$\rightarrow \int_0^T i_{ef}^2 \cancel{R}\,dt = \int_0^T i^2 \cancel{R}\,dt \;;\quad i_{ef} \int_0^T dt = \int_0^T i^2\,dt$$

$$\therefore i_{ef} = \sqrt{\frac{1}{T}\int_0^T i^2\,dt}$$

// Segundo Momento

Varianza o (Desviación Estandar)^2

$$\therefore i_{ef}^2 = \frac{1}{T}\int_0^T i^2\,dt$$

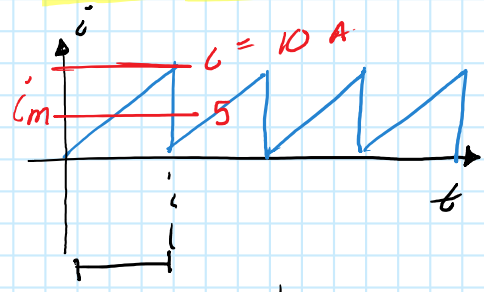
$$= \frac{1}{T}\int_0^T I_{max}\,\text{sen}^2\omega t\,dt$$

$$= \frac{I_{max}}{T}\int_0^T \frac{1}{2} - \frac{1}{2}\cos 2\omega t\,dt =$$

$$= \frac{I_{max}}{T}\left[\frac{1}{2}T - \frac{1}{4\omega}\left(\cancel{\text{sen}\,2\omega t - \text{sen}\,0}\right)\right] =$$

$$i_{ef}^2 = \frac{I_{max}}{\sqrt{2}}$$

Ejercicio



T = 20 segundos

$$i = \frac{10}{20} t$$ Pendiente

$$i_{ef}^2 = \frac{1}{T}\int_0^{20} \left(\frac{1}{2} t\right)^2 dt =$$

$$= \frac{1}{4T}\int_0^{20} t^2\, dt$$

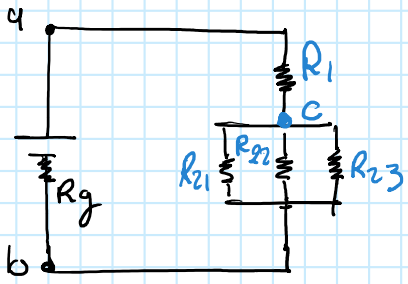
$$= \frac{1}{80}\left[\frac{1}{3} t^3\right]\Big|_0^{20} =$$

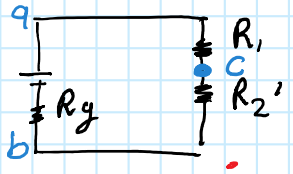
$$i_{ef}^2 = \frac{1}{(80)(3)}(80)^3 = \frac{100}{3} \cong 33.333$$

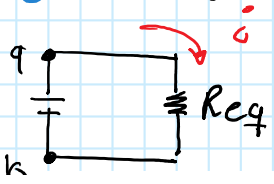
$$i_{ef} = 5.77\,[A]$$

Circuito C.D

① Determinar las corrientes en cada ramal
② Determinar las diferencias de potencial requeridas
③ Determinar la eficiencia de los generadores o motores eléctricos







// Datos

$V_{ab} = 12\,[V]$

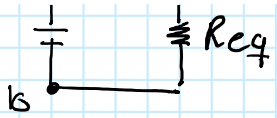
$R_1 = 3\,\Omega$

$R_{21} = 4\,\Omega$

$R_{22} = 5\,\Omega$

$R_{23} = 6\,\Omega$

$R_g = 1\,\Omega$



$$\frac{1}{R_2} = \frac{1}{4} + \frac{1}{5} + \frac{1}{6} \; ; \; R_2 = \frac{60}{37} [\Omega]$$

- $R_{eq} = R_1 + R_2 + R_g = 5.62 [\Omega]$

- $V = R i \; ; \; i = \frac{V}{R_{eq}} = \frac{12}{5.62} = 2.13$ [Amperes]

// Voltaje

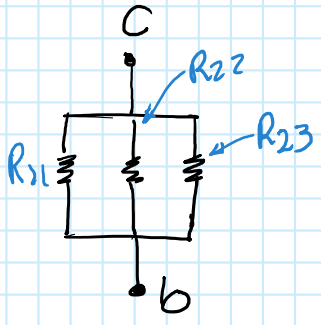
→ $V_{ac} = i R_1 = (2.13)(3) = 6.39611$ [V]

→ $V_{cb} = i R_2 = (2.13)\left(\frac{60}{37}\right) = 3.46$ [V]

→ $V_{eng} = i R_g = (2.13)(1) = 2.13$ [V]

$\therefore V_{ab} = V_{ac} + V_{cb} + V_{eng} \; ; \; 12 \cong 6.39611 + 3.46 + 2.13$

// Corrientes



// Nodo en el que se desea saber corrientes

$i_{21} = \frac{V_{cb}}{R_1} = .865$

$i_{22} = \frac{V_{cb}}{R_2} = .695$

$i_{23} = \frac{V_{cb}}{R_3} = .577$

$i = i_{21} + i_{22} + i_{23}$

$2.13 = .865 + .695 + .577$

// Eficiencia $\triangleq \eta$ (Bateria)

2° Ley Termodiná

Maquina de movimiento perpetúo de 2° orden

(Batería) η

$$\eta = \frac{\text{Pot. Salida}}{\text{Pot. entrada}}$$

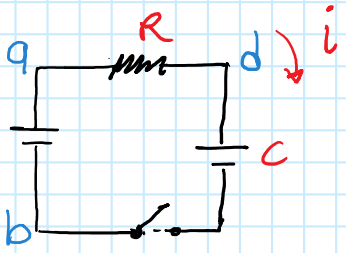
Termodinámica

perpetúo de 2° orden es imposible

$$Pot_{entrada} = Vi \quad ; \quad V' = V - ir_g$$
$$Pot_{salida} = V'i$$

$$\therefore \eta = \frac{V'i}{Vi} = \frac{V - ir_g}{V}$$

Circuito R.C.



$$\rightarrow V_{ab} = V_{ad} + V_{db}$$
$$= iR + \frac{1}{C}q$$

$$\bullet\ i = \frac{dq}{dt}$$

$$\therefore V_{ab} = R\frac{dq}{dt} + \frac{1}{C}q \ ;$$

$$V_{ab}C = RC\frac{dq}{dt} + q \ ; \quad V_{ab}C - q = RC\frac{dq}{dt}$$

$$\cancel{V_{ab}}^{cte}C - q = x$$
$$dx = -dq \quad ; \quad x = RC\frac{-dx}{dt} \ ;$$

$$\int_{x_0}^{x}\frac{dx}{x} = \int_{t_0}^{t}\frac{-dt}{RC} \quad ; \quad \ln\left(\frac{x}{x_0}\right) = \frac{1}{RC}(t - t_0)$$

// En el $t=0$

$q=0 \ ; \ x_0 = V_{ab}C$

$$\therefore \frac{x}{x_0} = e^{-\frac{t}{RC}} \ ;$$

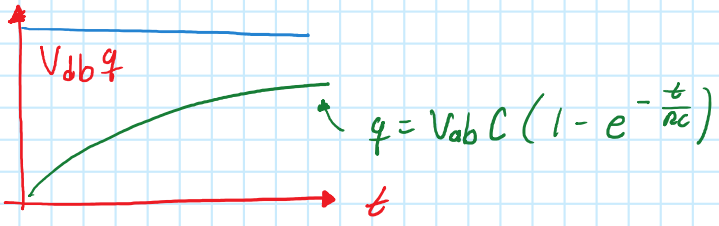
$$x = x_0 e^{-\frac{t}{RC}}$$

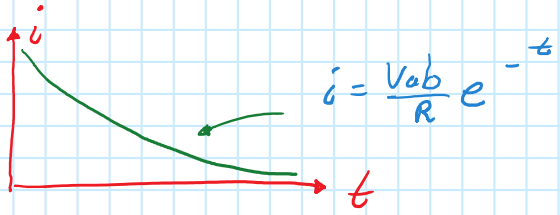
$$V_{ab}C - q = x_0 e^{-\frac{t}{RC}} \; ; \; q = V_{ab}C\left(1 - e^{-\frac{t}{RC}}\right)$$

$$V_{db} = \frac{q}{C} = V_{ab}\left(1 - e^{-\frac{t}{RC}}\right)$$

$$i = \frac{V_{db}}{R} = \left(\cancel{-} V_{ab}\cancel{C}\right)\left(\cancel{-}\frac{1}{R\cancel{C}}\right) e^{-\frac{t}{RC}} =$$

$$i = \frac{V_{ab}}{R} e^{-\frac{t}{RC}}$$





//Gráficas de Circuitos RC

26_Clase

lunes, 13 de mayo de 2019 07:16 a. m.

- Circuitos → RC → DC

▸ Circuito RC

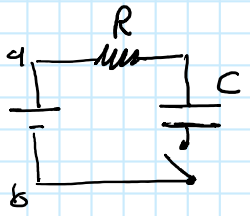
$$q = V_{ab} C \left(1 - e^{-\frac{t}{RC}}\right)$$

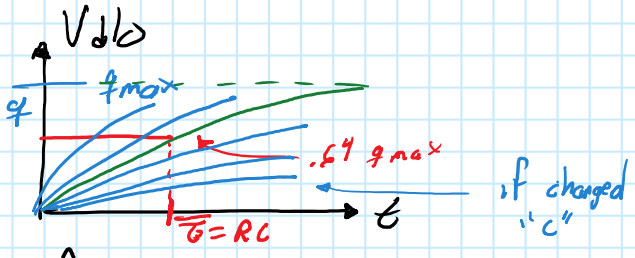
$$V_{db} = V_{ab} \left(1 - e^{-\frac{t}{RC}}\right)$$

$$i = \frac{V_{ab}}{R} \left(1 - e^{-\frac{t}{RC}}\right)$$

- $i = \frac{dq}{dt}$ • $i = \frac{q}{v}$

$$V_{ab} = V_{ad} + V_{db}$$





if $t = 0$; $q = 0$

if $t \to \infty$; $q = V_{ab} C$

$e^{-\infty}$; $\frac{1}{e^{\infty}} \to 0$

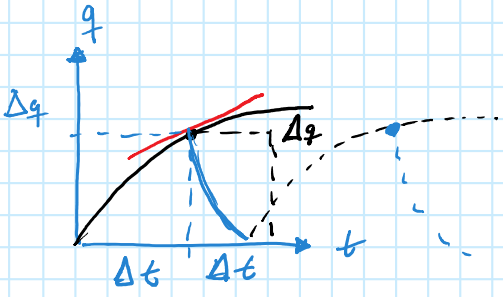
$$V_{db\,max} = V_{ab}$$

▸ $q = q_{max} \left(1 - e^{-\frac{t}{RC}}\right)$

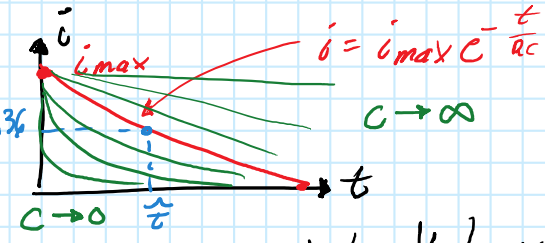
if $t = RC = \tau$ //Son parámetros del circuito

$$q = 1 - e^{-1} = 1 - \frac{1}{e} = .64\ q_{max}$$

$$\therefore V_{db} = .64\ V_{ab}$$ //



//Modelo de conocimiento



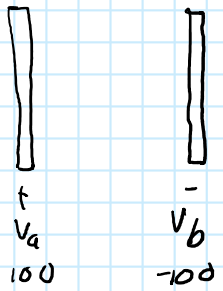
if $t = 0$; $i = \frac{V_{ab}}{R} = \frac{V_{admax}}{R}$

if $t \to \infty$; $i = 0$

if $t = \tau$; $i = .36 \frac{V_{ab}}{R}$

$$\therefore i_{max} = \frac{V_{admax}}{R} = \frac{V_{ab}}{R}$$

▸ Circuito CD



$V = \frac{E_u P}{q}$

$E_u P = V q$

if $q > 0$

$\therefore E_u P_a = 100 q$

$E_u P_b = -100 q$

$E_u P_b < E_u P_a$

$\Delta E_u P \Big|_a^b < 0$

if $q < 0$

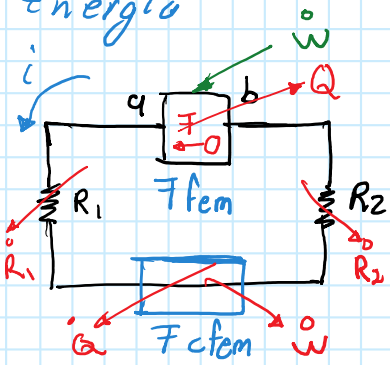
$E_u P_b = (-100)(-q) = 100 q$

$E_u P_a = 100(-q) = -100 q$

$E_u P_a < E_u P_b$

$\Delta E_u P \Big|_b^a < 0$

- Sin importar la carga siempre pierde energía



- $\mathcal{F}$ fem $\triangleq$ Fuente de fuerza electromotriz
- $\mathcal{F}$ cfem $\triangleq$ Fuente de fuerza contra-electromotriz
- Sistema Cerrado

▸ Fuente de Fuerza Electromotriz

- Un lugar en donde las partículas cargadas eléctricamente ganan energía, mediante la realización de un trabajo.

▸ Fuente de Fuerza contra-electromotriz

- Un lugar en donde las partículas cargadas eléctricamente pierde energía mediante la realización de un trabajo

- $\text{Velocidad}_{\text{media}} = \text{Velocidad de arrastre} \triangleq \text{cte}$

$Q + W = \Delta E_u$ ← First Law Termodynamic

En ciclo $\Delta E_u = 0$

$\dot{Q} + \dot{W} = 0$

$P_{entrada} = P_{salida}$

$\mathcal{E} \triangleq$ Fuerza Electromotriz

$\mathcal{E} = \frac{dE_u}{dq} \left[\frac{\text{Joule}}{\text{Coulomb}}\right] = [V]$

$dE_u \triangleq$ Energía transformada de

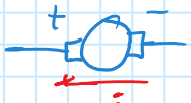
$P_{entrada} = P_{salida}$

$dE_u \triangleq$ Energía transformando de no eléctrica a eléctrica ($\mathcal{F}$ fem) de manera reversible ($\mathcal{F}_C$ fem)

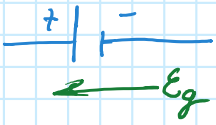
▶ E_u No elec $\rightarrow$ E_u ele

$\mathcal{F}$ fem

1) Generador;



2) Pila o Baterías;



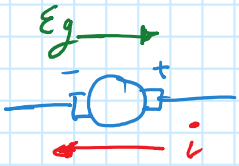
1) E_u Mc $\rightarrow$ E_u Eléctrica

2) E_u Químico $\rightarrow$ E_u Eléctrica

▶ E_u ele $\rightarrow$ E_u No elec

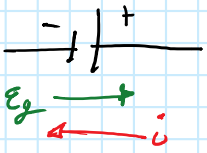
$\mathcal{F}_C$ fem

1) Motor eléctrico



// Perder energía

2)



• $P_{ent} = P_{salida}$

$\mathcal{E}_g i = P_{ent}$

$\therefore P_{sal} = \mathcal{E}_{em} i + i^2 R_1 + i R_2 + i^2 r_g + i^2 r_m$

$\mathcal{E}_g i = \mathcal{E}_m i + \Sigma i^2 R$

$\mathcal{E}_g = \mathcal{E}_{em} + \Sigma i R$

$\mathcal{E}_g (-\mathcal{E}_{em}) = i \Sigma R$

$i = \dfrac{\Sigma \mathcal{E}}{\Sigma R}$ Ecuación del Circuito

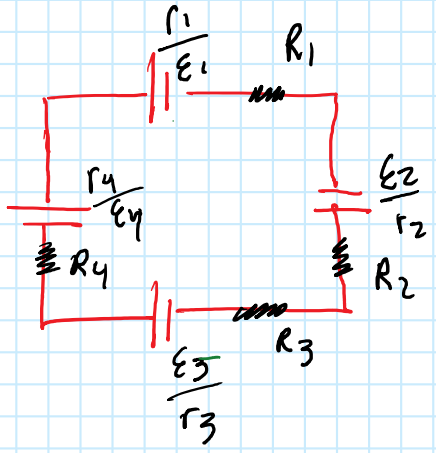
$\mathcal{E} = \dfrac{dE_u}{dq}$; $dE_u = \mathcal{E}\, dq$

$P_{sal} = \dfrac{dE_u}{dt} = \dfrac{\mathcal{E}\, dq}{dt} = \mathcal{E} i$

$\Sigma \mathcal{E} = \mathcal{E}_g + (-\mathcal{E}_m)$

Resolver Circuito

1] Asignar un sentido arbitrario en cada ramal
2] Asignar un sentido arbitrario de recorrido
3] Considerar que todas las $\mp$ fem se comportan como generadores (De menos a más)
4] Aplicar la ecuación del circuito
5] Determinar cuales son fuentes y cuales motores
6] Calcular la eficiencia de cada $\mp$ fem
7] Calcular las $\dot{V}$ requeridas



Datos

$\mathcal{E}_1 = 100[V]$ $\quad r_1 = 4\ \Omega$

$\mathcal{E}_2 = 40\ [V]$ $\quad r_2 = 3\ \Omega$

$\mathcal{E}_3 = 30\ [V]$ $\quad r_3 = 2\ \Omega$

$\mathcal{E}_4 = 10\ [V]$ $\quad r_4 = 1\ \Omega$

$R_1 = 6\ \Omega$ $\quad R_3 = 10\ \Omega$

$R_2 = 8\ \Omega$ $\quad R_4 = 12\ \Omega$

// Calcular

- $i = ¿?$